FAST RESPONSE FIBRE BRAGG GRATING (FBG) PRESSURE TRANSDUCER

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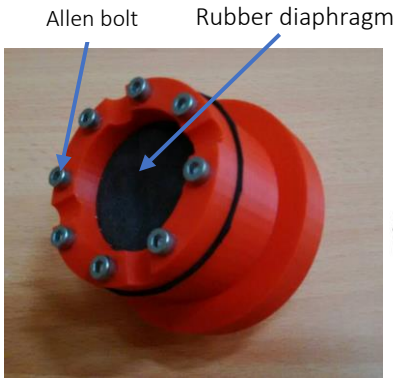
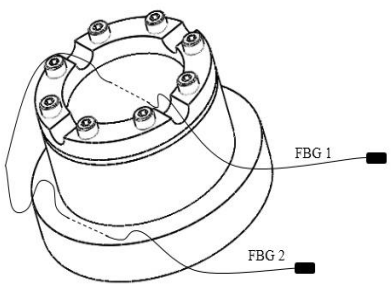
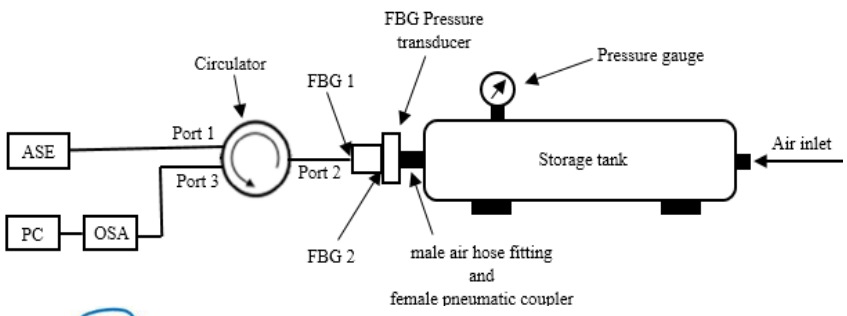
PRODUCT / BACKGROUND

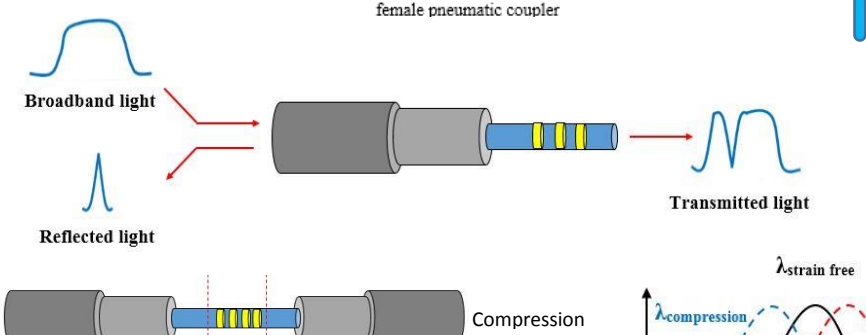
FBG pressure sensor has shown a great potential in replacing conventional electrical pressure sensor due to its adaptability to harsh environment. However, increasing its sensitivity is still a challenge. In this work, bonding of FBG to a rubber-based diaphragm pressure transducer was proposed and experimentally presented. The improved design of the rubber-based diaphragm has enhanced the sensitivity and sensing range recorded at 118.03 nm/MPa or 7.614 x 10^{-2} MPa^{-1} across a range of 0.08 MPa with a good linearity of 99.8%. Furthermore, the thermal-strain cross sensitivity was totally compensated.

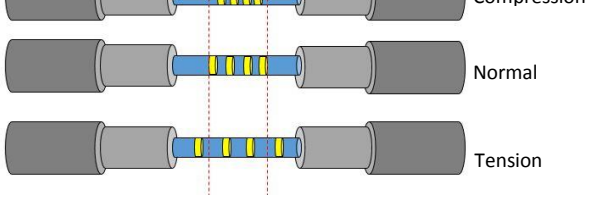
STATE-OF-ARTS

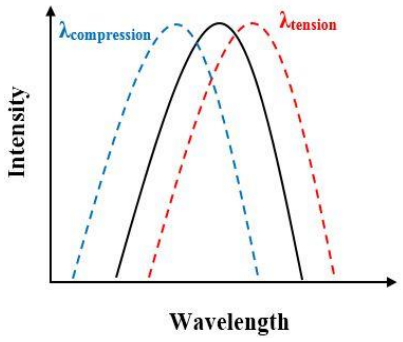






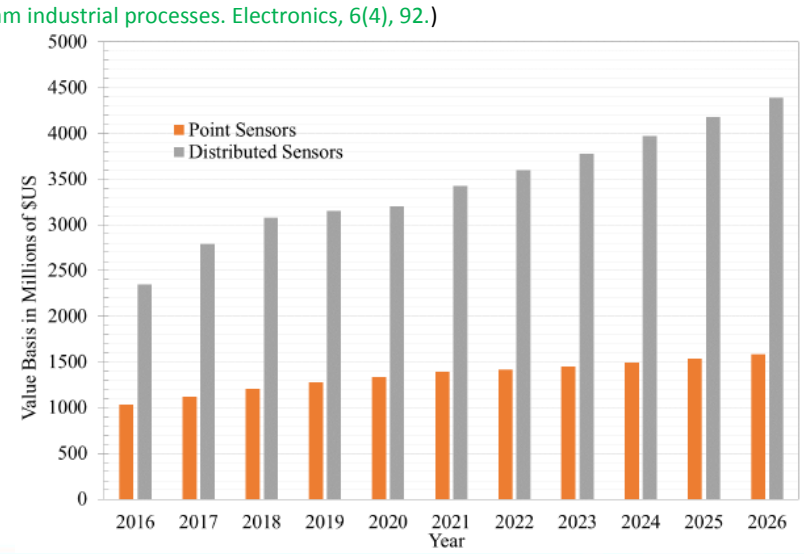






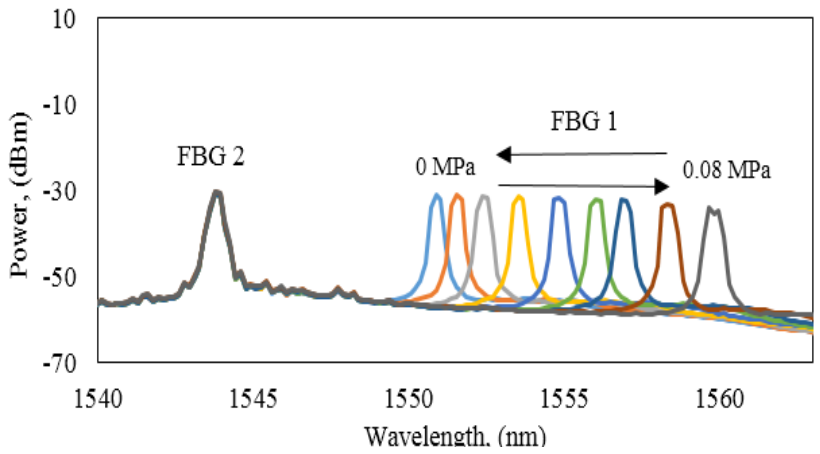
MARKETABILITY

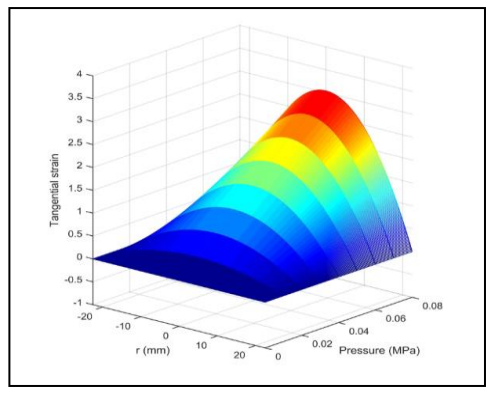
The report by ElectroniCast from May 2017 predicts the fibre optic sensor (FOS) market will increase at a compound annual growth rate (CAGR) of 7.35% from US$3.38 billion (RM13.14 billion) in 2016 to US$4.82 billion (RM18.74 billion) in 2021 and then at a CAGR of 4.41% to US$5.98 billion (RM23.26 billion) by 2026. (source: Allwood, G., Wild, G., & Hinckley, S. (2017). Fiber bragg grating sensors for mainstream industrial processes. Electronics, 6(4), 92.)

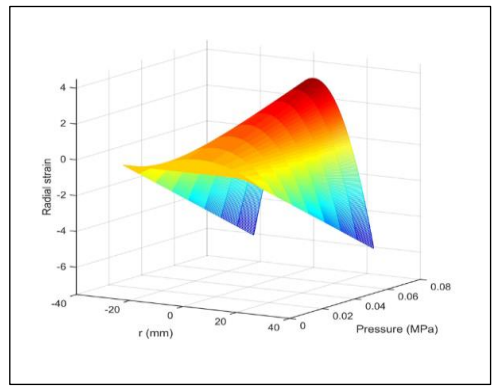


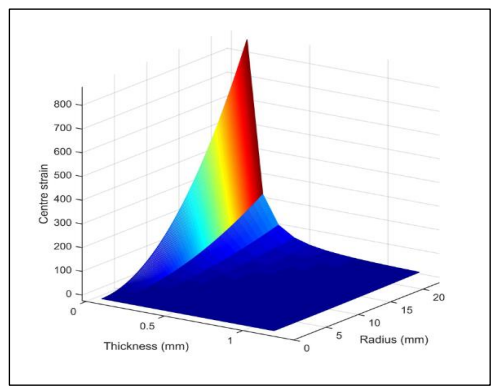
PRODUCT CHARACTERISTICS

Authors	Methods	Range, (MPa)	Sensitivity, (nm/MPa)	% comparison
(Liu, Li, Zhao, Wang, & Liu, 2017)	Design of FBG sensor based on bending plate beam structure	**14**	**0.133**	**887.44**
(Liang, Fang, Wu, Xue, & Li, 2017)	Bonding of FBG to a diaphragm-cantilever	**10**	**0.34**	**347.15**
(Havreland, Petersen, Østergaard, Reck - Nielsen, & Thomsen, 2017)	Design of FBG sensor based on micro fabrication technique	**0.1**	**6**	**19.67**
(Chen, Zhang, & Wu, 2017)	Bonding of FBG to a metal bellows	**0.2**	**11.96**	**9.87**
(Pachava et al., 2015)	Bonding of FBG to a metal bellows	**0.28**	**13.14**	**8.98**
Proposed method	***Bonding of FBG to a natural rubber diaphragm***	***0.08***	***118.03***	**-**









NOVELTY

- Real-time wavelength pressure monitoring from spectrum analyzer device.
- New diaphragm-type design based on low Young's modulus natural rubber.
- The pressure transducer was joined with 12 mm x 40 mm male air hose fitting which gives universal snap-fit applications to any 12 mm female pneumatic coupler.

ACHIEVEMENTS

- Creation, Innovation, Technology & Research Exposition (CITREX) 2018 – Top 10 Gold medal
- Creation, Innovation, Technology & Research Exposition (CITREX) 2017 – Silver medal
- International Invention, Innovation and Technology Exhibition (ITEX) 2017 – Silver medal
- Creation, Innovation, Technology & Research Exposition (CITREX) 2016 – Silver medal
- Advanced Innovation & Engineering Exhibition (AiNEX) 2016 – Gold medal with best awards

PUBLICATIONS

ISI

- Hafizi, Z. M., Epaarachchi, J., & Lau, K. T. (2015). Impact location determination on thin laminated composite plates using an NIR-FBG sensor system. *Measurement*, *61*, 51-57. **Q2-IF: 1.742**
- Vorathin, E., Hafizi, Z. M., Ghani, S. A. Che., Siregar, J. P., & Lim, K. S. (2017). FBGs Real-Time Impact Damage Monitoring System of GFRP Beam Based on CC-LSL Algorithm. *International Journal of Structural Stability and Dynamics*, *18*(5), 1850075. **Q2-IF:1.617**
- Vorathin, E., Hafizi, Z. M., Aizzuddin, A. M., & Lim, K. S. (2018). A highly sensitive multiplexed FBG pressure transducer based on natural rubber diaphragm and ultrathin aluminium sheet. *Optics & Laser Technology*, 106, 177-181. **Q2-IF: 2.109**

SCOPUS

- Zohari, Mohd Hafizi, Yusof, Mohd Fadhlan, Siregar, Januar Parlaungan, & Sing, Lim Kok. (2015). The Applications of FBG sensor for Realtime Strain Mapping of Thin Composite Plate under Point Loading. *J. Electrical Systems Special issue AMPE2015*.

BENEFITS / USEFULNESS

- Enable continuous monitoring of pressure.
- Real-time data allows immediate real-time decision making.
- Predictive maintenance becomes more efficient and less labor

COLLABORATORS

Academic institution

- Photonics Research Centre, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia

Interested company

- NineSigma, Inc.
- GE Power

PATENT

- Title: ***"Highly sensitive FBG pressure transducer ".*** Currently under utility innovation drafting.